

California Pest Rating Proposal for

Paratrichodorus spp. (Siddiqi 1974) and *Trichodorus* spp. (Cobb 1913)

Stubby-root nematodes

Current Pest Rating: **D**

Proposed Pest Rating: **C**

Comment Period: **09/04/2019 through 10/19/2019**

Initiating Event:

During the 1950-60s, several genera of plant parasitic nematodes were given a 'D' rating as they were regarded as parasites, predators, or organisms of little or no economic importance that did not require State-enforced regulatory action. However, these nematode species were inaccurately assigned a 'D' rating as most, if not all, are plant parasitic and therefore capable of damaging plant production and causing significant economic losses especially at the county and local residential/grower level. Furthermore, the detection of plant parasitic nematodes in nursery stock may be an indication of contamination in violation of the State's standard of pest cleanliness required for nurseries. *Paratrichodorus* spp. and *Trichodorus* spp. (stubby-root nematodes) were originally rated 'D'. The risk of infestation and permanent rating of these genera are re-assessed here.

History & Status:

Background: Generally, pest risk assessments and assignment of pest ratings are conducted *per* individual pest species and not *per* genus group primarily due to differing pest biologies, geographical distributions, host ranges, damage potentials, and risk mitigating requirements. However, an exception to this rule is made here for the genera *Paratrichodorus* and *Trichodorus* largely because of historical practice. Over the past several decades, the nematodes in the genera *Paratrichodorus* and *Trichodorus* were seldom differentiated to species level by CDFA Nematologists mainly due to 1) the common occurrence and wide distribution of important member species within California, 2) no state-enforced regulatory action required subsequent to their detection, and 3) prioritizing diagnosis of other nematode species in other genera

considered to be of greater economic importance than those belonging to *Paratrichodorus* or *Trichodorus*.

Members of the genera *Paratrichodorus* and *Trichodorus* have the common name of “stubby-root nematodes”. Species reproduce mainly by parthenogenesis; unmated females produce eggs, juvenile stages, and adults. Males are rare. These nematodes usually inhabit the soil-root region of the plant and feed as obligate, migratory ectoparasites of roots using a stylet to feed on epidermal cells. All motile juvenile and adult stages feed (Mai et al., 1996; Maggenti, 1981)

Hosts: *Paratrichodorus* spp. and *Trichodorus* spp. are associated with the roots of a wide range of plants including tobacco, cotton, oats, corn, other agricultural crops, fruit trees, ornamentals, nursery stock, forest trees and shrubs, desert shrubs, grasses, and weeds (Nemaplex, 2019; CABI, 2019). Database records show the widespread occurrence of *Paratrichodorus* spp. and *Trichodorus* spp. in soil and in plant rhizospheres, but plant parasitism has not always been supported by other research or observations, and the severity has not often been quantified.

Symptoms: General plant damage associated with *Paratrichodorus* spp. and *Trichodorus* spp. includes stunting of the root system, which is expressed aboveground by yellowing of foliage, stunted top growth, and sometimes wilt and defoliation (Maggenti, 1981). Symptomatic plants often occur as irregularly-shaped patches within a field. Impacts are generally more severe in sandy and light soils. Seedlings are the most seriously damaged. As the seedling roots develop, the tips are attacked, and growth stops. The roots will appear “stubby” and shortened because feeding by the nematode causes the root tips to fail to grow as it inhibits root elongation. The roots will branch at the points of nematode feeding and then the new root tips can also be attacked (Christie and Perry, 1951). The damaged roots are less able to take up water and nutrients from the soil and the plants may show nutrient deficiency symptoms. Affected plants may fall over more easily in the wind (MacGowan, 1983). Plant roots usually show little or no necrosis or discoloration (Christie and Perry, 1951; Brodie, 1984). Stubby root nematodes are vectors of tobnaviruses including tobacco rattle tobnavirus that causes corky ringspot disease of potato. The virus can be vectored by several species of *Paratrichodorus* spp. and *Trichodorus* spp. (Weingartner et al., 1983; Ingham et al., 2007).

Transmission: The main mode of long and short distance spread through artificial means, primarily movement of nematode-contaminated water (run-off and irrigation) and soil (movement of tools and equipment).

Damage Potential: Generally, *Paratrichodorus* spp. and *Trichodorus* spp. are considered mild pathogens of plants and are common associates of several plants (Siddiqi et al., 1973). However, plant damage caused by high populations of stubby root nematodes may be more significant in small-area plant productions and/or containerized crops in

nursery, residential, and local situations than in large acreages and environments such as, pastures, parks, and cultivated fields. Crop losses under field conditions are not reported. However, under experimental conditions, reductions in root and plant growth have been demonstrated by certain species, e.g., *P. porosus* on Chinese yams (Nishizawa et al., 1973) and *P. minor* on corn (Crow, 2004). Increased damage occurs when *Paratrichodorus* spp. vector tobacco rattle tobravirus (Zwieg and Hudelson, 2010). Crop damage under field conditions may be difficult to attribute to *Paratrichodorus* spp. and *Trichodorus* spp. as species of these genera are often found with those of other genera and it is also common to find multiple species of *Paratrichodorus* or *Trichodorus* living together, which makes it difficult to attribute damage to a single species. (CDFA pest and damage records, 2019).

Worldwide Distribution: *Paratrichodorus* spp. and *Trichodorus* spp. are distributed worldwide in tropical, sub-tropical, and temperate areas.

Official Control: Currently, *Paratrichodorus* spp. and *Trichodorus* spp. are D rated pests in California (see 'Initiating Event'). *Paratrichodorus* spp. are on the 'Harmful Organism Lists' for China, Egypt and Jordan (USDA-PCIT, 2019).

California Distribution: *Paratrichodorus* spp. and *Trichodorus* spp. have been distributed throughout California for many years (Siddiqi et al., 1974).

California Interceptions: For the past several decades, *Paratrichodorus* spp. and *Trichodorus* spp. have been detected in many imported plant and soil shipments intercepted in California.

The risk *Paratrichodorus* spp. and *Trichodorus* spp. would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** *Paratrichodorus* spp. and *Trichodorus* spp. will be able to establish throughout the state

Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: 3

- Low (1) Not likely to establish in California; or likely to establish in very limited areas.
- Medium (2) may be able to establish in a larger but limited part of California.
- **High (3) likely to establish a widespread distribution in California.**

- 2) Known Pest Host Range:** *Paratrichodorus* spp. and *Trichodorus* spp. are known to be associated with diverse plant species, however, the host status of associated plants is not always known.

Evaluate the host range of the pest.

Score: 3

- Low (1) has a very limited host range.
- Medium (2) has a moderate host range.
- **High (3) has a wide host range.**

- 3) Pest Reproduction Potential:** The main mode of long and short distance spread is through artificial movement of contaminated plants, soil and water. *Paratrichodorus* spp. and *Trichodorus* spp. are parthenogenic with a high reproduction potential.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 3

- Low (1) does not have high reproductive or dispersal potential.
- Medium (2) has either high reproductive or dispersal potential.
- **High (3) has both high reproduction and dispersal potential.**

- 4) Economic Impact:** Generally, *Paratrichodorus* spp. and *Trichodorus* spp. are considered mild pathogens of plants. However, under high population levels in residential, nurseries, and other small-area plantings, *Paratrichodorus* spp. and *Trichodorus* spp. infections could result in lowered crop yield, and they can vector plant disease viruses.

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, E

- A. The pest could lower crop yield.**
- B. The pest could lower crop value (includes increasing crop production costs).
- C. The pest could trigger the loss of markets (includes quarantines).
- D. The pest could negatively change normal cultural practices.
- E. The pest can vector, or is vectored, by another pestiferous organism.**
- F. The organism is injurious or poisonous to agriculturally important animals.
- G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: 2

- Low (1) causes 0 or 1 of these impacts.
- **Medium (2) causes 2 of these impacts.**
- High (3) causes 3 or more of these impacts.

- 5) Environmental Impact:** The impact of *Paratrichodorus* spp. and *Trichodorus* spp. on natural environments is most likely not significant as the species is already widespread without causing apparent detriment to ecological balances and processes.

Environmental Impact: Low

- A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
- B. The pest could directly affect threatened or endangered species.
- C. The pest could impact threatened or endangered species by disrupting critical habitats.
- D. The pest could trigger additional official or private treatment programs.
- E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 1

- **Low (1) causes none of the above to occur.**
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Paratrichodorus* spp. and *Trichodorus* spp. is Medium:

Add up the total score and include it here. **12**

-Low = 5-8 points

-Medium = 9-12 points

-High = 13-15 points

- 6) Post Entry Distribution and Survey Information:** *Paratrichodorus* spp. and *Trichodorus* spp. are widely distributed across the state.

Evaluation is 'High'

Score: -3

-Not established (0) Pest never detected in California or known only from incursions.

-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).

-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.

-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

- 7) The final score is the consequences of introduction score minus the post entry distribution and survey information score:**

Final Score: Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = **12-3=9**

Uncertainty:

None.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Paratrichodorus* spp. and *Trichodorus* spp. is C.**

References:

- Brodie, B. B. 1984. Nematode parasites of potato. In: Nickle WR, ed. Plant and Insect Nematodes. New York, USA: Marcel Dekker, 167-212.
- Christie, J. R., and Perry, V.G. 1951. A root disease of plants caused by a nematode of the genus *Trichodorus*. Science 113: 491-493.
- Crow, W. T. 2004. *Paratrichodorus minor*. EENY-339. University of Florida, IFAS
- Ingham, R. E., Hamm, P. B., Baune, M. and Merrifield, K. J. 2007. Control of *Paratrichodorus allius* and Corky Ringspot Disease in Potato with Shank-injected Metam Sodium. Journal of Nematology. 39: 258-262
- Mai, W. F., P. G. Mullin, H. H. Lyon, and K. Loeffler. 1996. Plant parasitic nematodes – a pictorial key to genera. Fifth Edition. Comstock Publishing Associates a division of Cornell University Press, Ithaca and London. 277 p.
- Maggenti, A. 1981. General nematology. Springer-Verlag New York Heidelberg Berlin. 372 p.
- MacGowan, J. B. 1983. The stubby-root nematode, *Paratrichodorus christiei* (Allen 1957) Siddiqi 1974. Nematology Circular, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, No.97:2 pp.
- Nishizawa, T. 1973. Pathogenicity of *Trichodorus porosus* to Chinese yam. Japanese Journal of Nematology. 3: 33 – 37
- Siddiqi, I. A., Sher, S. A. and French, A. M. 1973. Distribution of Plant Parasitic Nematodes in California. State of California Department of Food and Agriculture, Division of Plant Industry. 324p.
- Siddiqi, M. R. 1974. Systematics of the genus *Trichodorus* Cobb, 1913 (Nematoda: Dorylaimida), with descriptions of three new species. Nematologica, 19: 259 – 278.
- USDA-PCIT. 2019. United States Department of Agriculture, Phytosanitary Certificate Issuance & Tracking System (PCIT). <https://pcit.aphis.usda.gov/PExD/faces/ViewPExD.jsp>.
- Walkinshaw, C.G., Griffin, G. D, and Larson, R. H. 1961. *Trichodorus christiei* as a vector of potato corky ringspot (tobacco rattle virus). Phytopathology 51: 806-808.
- Zwieg, R., and Hudelson, B. 2010. Tobacco Rattle. University of Wisconsin garden fact sheets. <https://pddc.wisc.edu/2015/08/18/tobacco-rattle/> Accessed 7/31/19

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, California Department of Food and Agriculture, 204 West Oak Ave, Lompoc, CA 93436. Phone: 805-736-8050, [plant.health\[@\]cdfa.ca.gov](mailto:plant.health[@]cdfa.ca.gov).

***Comment Period: 09/04/2019 through 10/19/2019**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at [plant.health\[@\]cdfa.ca.gov](mailto:plant.health[@]cdfa.ca.gov).

Comment Format:

- ❖ Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

Example Comment:

Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to “Climate/Host Interaction” here.]

- ❖ Posted comments will not be able to be viewed immediately.
- ❖ Comments may not be posted if they:
 - Contain inappropriate language which is not germane to the pest rating proposal;
 - Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;
 - Violates agency regulations prohibiting sexual harassment or other forms of discrimination;
 - Violates agency regulations prohibiting workplace violence, including threats.

- ❖ Comments may be edited prior to posting to ensure they are entirely germane.
- ❖ Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: C